HEATER ASSEMBLY INCLUDING THERMAL FUSE

BACKGROUND

[0001] The present exemplary embodiments relate to printing or copying systems and, in particular, printing devices which utilize an intermediate transfer service such as a transfer drum which is intended to engage a receiving medium such as paper for imparting a desired image from the drum to the medium. The subject embodiments are especially applicable to printing devices which utilize a supply of colored inks to be communicated to a print head for document printing wherein the inks are supplied as solid ink sticks which must be heated to a liquid form before communication to the print head. Such systems are commercially available under the PHASER® mark from Xerox Corporation. The heating of the ink to effect the solid-to-liquid phase change is usually associated with corresponding heating of other components of the assembly, such as the drum and the medium itself before engagement with the drum. The subject embodiments are particularly directed to the structure and method of operation of the heater for the preheating of the medium prior to the transfer process.

[0002] All printers and copying machines have to be designed with an appreciation that at some time a power control failure may occur within the system and that such failure should not expose an operator or a repairman to a dangerous situation such as exposure to electrical shock or thermal burning. Indeed, a typical safety requirement (UL required) is that any component that has line voltage and is accessible by a user or operator must have enough insulation protection to have a dielectric strength of at least 3KV between the user accessible parts, ground plane, secondary circuits and the line. This safety regulation must be met not only by new componentry but also by componentry that has been exposed to thermal run-away conditions that can damage the insulation.

[0003] The subject embodiments concern the operation and assembly of a medium preheater in a printing system, which preheater is a typical component subject to the above safety requirements. The conventional construction of such a heater involves a pattern of heat traces laminated to a metallic support plate. The support plate is disposed to engage the medium for the heating of the medium

immediately prior to its engagement with the intermediate transfer drum and the imparting of a desired image from the drum to the medium. Laminating of the heat traces to the support plate involves insulating a layer therebetween which under normal use conditions would satisfy the 3KV dielectric strength requirement. However, the heat traces in such a system are typically capable of reaching relatively extreme temperatures (about 1200°C) which is a temperature that is easily capable of burning away an insulating layer between the heat traces and the support plate. The plate would then function as a ground plane for the electrical supply to the traces thereby grounding the line voltage to the component. Such an occurrence would fail to meet the above-referenced safety requirements.

[0004] There is a need for a heater assembly which is properly fused to interrupt this supply of electrical power to the heater in the event of a thermal run-away and at a point in time prior to the thermal run-away causing unacceptable damage to the pattern of heat traces themselves and/or the insulating layer separating the heat traces from the metallic support plate.

[0005] The present exemplary embodiments satisfy this need as well as others to provide a power control system for medium heaters in phasing printing systems that can provide the desired safety protection against power control failures that may cause thermal run-aways in the system.

BRIEF DESCRIPTION

[0006] A printing system is provided wherein a transfer drum imparts a desired image on a medium for imprinting the image on the medium. A heater is provided for preheating the medium to a selected temperature prior to the imprinting for facilitating reception of the image on the medium from the drum. The heater preferably includes two fuses, one fuse on the line lead and the other on the neutral lead, for interrupting a supply of power to the heater upon an undesired increase in the power supply and consequent overheating of the heater. The heater comprises a pattern of heat traces bonded to a support plate. The fuses are disposed in electrical series with the pattern of heat traces for opening the power supply circuit upon the opening of the fuses. The fuses comprise thermal fuses. A thermal storage member is associated with the pattern of heat traces and disposed relative

to the fuses for communicating the thermal energy increase to the extent to open the fuses before more damaging thermal run-away.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIGURE 1 is a diagrammatical illustration of a substantial portion of one of the embodiments particularly illustrating the disposition of the medium heater relative to an intermediate transfer drum;

[0008] FIGURE 2 is a planar view of a medium preheater;

[0009] FIGURE 3 is an expanded cross sectional stack up of one embodiment of preheater material layup; and

[0010] FIGURE 4 is a diagrammatical illustration of a preheater assembly.

DETAILED DESCRIPTION

[0011] FIGURE 1 discloses a diagrammatical illustration of a printing system **10** wherein an ink image is transferred from an intermediate transfer surface, e.g., transfer drum **14**, to a final receiving substrate **28**, e.g., a medium such as paper, transparency or the like. A print head **11** is supported by an appropriate housing and support elements (not shown) for either stationary or moving utilization to place an ink in the liquid or molten state on the intermediate transfer surface **12** of transfer drum **14**. Other shown basic elements of the assembly include applicator assembly **16** for applying a liquid layer forming the intermediate transfer surface **12** on the exterior of the drum **14**, a print head **11**, a drum heater **19**, stripper fingers **25** for removing the substrate from the transfer surface **12**, a guide **20** for guiding the substrate **28** through the system and fixing roller **22** for pressing the substrate **28** against the drum **14**. The construction and operation of a printing system employing these basic elements is well known to one of ordinary skill in the art.

[0012] Of particular importance for the subject application is the construction and operation of the heater **21** for preheating the substrate **28** prior to imprinting of the desired image thereon from the transfer drum **14**.

[0013] With particular reference to FIGURE 2, the support plate is comprised of a metallic, preferably aluminum, plate **30** having a relatively smooth surface for allowing a relatively frictionless slide of the substrate or medium **28** across it and for imparting enough thermal energy for heating the medium **28** to about 60°C. The

drum is maintained at a similar temperature. Such temperatures facilitate the printing process. The development of thermal energy within the plate **30** is accomplished through a laminar assembly **32**, including a pattern of heat traces **34** serially connected to the power leads **36**, comprising a line lead and a neutral lead. A thermistor **40** is used to monitor the temperature of the heater **21** at the desired temperature for the proper heating of the medium **28** during normal operation. The traces 34 are interposed between the thermal fuses 38 and the leads **36** for interrupting the supply of power to the traces in the event of an undesired temperature increase such as may be caused by a thermal run-away. Thermal run-away would occur when the power supply to the heater **21** suffers a power control failure. For example, a triac switch (not shown) is usually employed to supply the power to the heater **21** and in the event of a triac failure or software problem, so much current can be supplied to the heater **21** that the heater trace **34** can burn up resulting in permanent damage to the trace and an insulation layer between the trace and the plate **30**. In such cases, a short may exist between the heater trace **34** and the plate thereby exposing an operator or user to an electric shock from a contact with the plate **30**. If power is still applied to either or only one end of the heater trace, the circuit could still be connected to ground through the breached insulation, hence the UI requirement for double insulation. Accordingly, the present embodiment comprises an assembly, which will insure opening of both fuses **38** in the case of an electrical run away.

[0014] With reference to FIGURE 3, a material stack up of the heater assembly is shown in exploded cross section. The stack up starts with the metallic plate **30** which will actually engage the medium. The plate **30** is insulated from the thermal storage member **44** by insulating material **42**, preferably comprising a single layer of Kapton **46** disposed between the heater foil traces **34** and the aluminum foil **44**. This assembly provides the dielectric strength of 3KV as required by the product specifications.

[0015] The heater foil **44** operates to disperse thermal energy generated by the traces **34** in two directions, both towards the plate **30** and back towards the fuses **38** as will be explained more in detail later. The foil **44** is adhered to insulating layer **46** by adhesive **48**. Heat traces **34**, are sandwiched between insulating layers **46**, **48** and adhered thereto by adhesive layers **50**, **52**. The construction of the assembly is

accomplished by intimately co-curing foil **44** with the remaining layers of the assembly and then adhering the heater **32** to the plate **30**.

[0016] As noted above, the overall objective of the subject embodiments is to provide a thermal mass **44** that will provide sufficient energy (a thermal flywheel) to assure that the second thermal fuse will open after the first fuse opened, dielectrically isolating both ends of the heater from electrical power, see Figure 4. Because of its placement and reduced mass relative to the heater plate **30** mass, mass **44** will experience a temperature change more rapidly than mass **30** and also due to its thermal isolation from mass **30** it will also maintain an elevated temperature longer after electrical power is removed. In a situation of unfused thermal run-away, it is possible for the traces to reach temperatures up to 1300°C which is clearly enough to melt most conventional insulating materials.

[0017] In one embodiment though, the insulating dielectric material **42** between the traces **34** and the support plate **30** is robust enough to avoid thermal degradation during such a trace melt down. In this embodiment storage foil **44** would be unnecessary, but the expense of putting a significant enough thermal resistance between the traces **34** and the plate **30** would cause a thickness in the dielectric which would be expected to cause a significant rise in heater costs. In addition, the thermal insulation and resistance between the traces **34** and the plate **30** would cause a reduction in efficiency of thermal communication to the plate **30**. However, the thermal run-away would be significant enough to cause the opening of the fuses **38** prior to degradation of the insulating layer **42** and a resulting short between the traces and the plate.

[0018] A second embodiment of the invention comprises the inclusion of the thermal storage foil **44** between the traces **34** and the plate **30**. In this embodiment, thermal run-away in the pattern of heat traces **34** is expeditiously communicated from the areas of the foil immediately contiguous to the pattern of heat traces to the area contiguous to the thermal fuses **38**. It should be kept in mind that the foil **44** is intended to be coplanar with the overall heater area **32**, and not just with the immediate area of the heat traces **34**. In other words, those areas which are more densely formed with heat trace patterns will have increased temperature rises during thermal run-away than areas not so close to the traces, i.e., the location of the fuses **38**. Accordingly, foil **44** will communicate thermal energy so generated in the areas

immediately adjacent the traces to the areas of the foil near the fuses **38**. In addition, during thermal run-away it is conceivable that the insulation and adhesive layers **46**, **48**, **50** between the heater trace **34** and the foil **44** could be so degraded due to thermal burn up that a short may occur between the foil and the traces. In such circumstances, the power to the traces will not be serially interrupted as the foil may itself serve as the necessary serial conductor. However, the continuous ramp up of the temperature in such a situation will eventually communicate enough temperature to the area of the foil contiguous to the fuses **38** so that the fuses will open and electrical energy to the traces will be interrupted so the traces are electrically isolated and unable to effect a short to the plate **30**.

[0019] In another embodiment, the foil **44** is not interposed between the plate **30** and the heat trace **34** but is disposed adjacent to insulating layer **48**, i.e., essentially on top of the trace and intermediate the trace pattern **34** and the fuses **38** for an even more efficient communication of thermal run-away to the fuses **38**. However, the embodiment of FIGURE 3 has the operational advantage of improvement in the overall thermal performance of the heater **32** by better dispersing the thermal energy from the heat trace **34** to the foil **44** and then to the plate **30**. This particular structure allows the heater to operate at a higher power density, making the heater **32** effectively smaller and less costly than the alternative designs.

[0020] The subject embodiments operate to satisfy the safety requirements to avoid a ground short between user accessible parts, even in the case of thermal run-away conditions.

[0021] The exemplary embodiments have been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS: